MAKERERE UNIVERSITY

COLLEGE OF HEALTH SCIENCES
DEPARTMENT OF PHARMACY

ASSESSMENT OF MEDICATION ERRORS AT THE IN-PATIENT WARDS OF ARUA REGIONAL REFERRAL HOSPITAL-ARUA DISTRICT, UGANDA

Investigators

BACIA LAURA 14/U/23069/PS

MWAWULE.W.FREDRICK 15/U/1690

Supervisor

Dr. KALIDI RAJAB

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MAY, 2019
DECLARATION

We declare that this dissertation is a novel work that has never been presented to any institution for any award.

Signature: MWA WULE W. FREDRICK  Date: 16/5/2017

Signature: BACIA LAURA  Date: 16/5/2019

This work has been approved by our supervisor

Signature:  Date: 16/5/2019  Dr. KALIDI RAJAB
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We do extend further thanks to our beloved lecturers Dr. KALIDI RAJAB and Dr. Kamba Pakoyo Fadhir, our class mates and friends as well.

We also extend our sincere thanks to other lecturers for having equipped us with enough knowledge to carry out this kind of research.
ACRONYMS

ARRH : Arua Regional Referral Hospital
ADEs : Adverse Drug Events
ADRs : Adverse Drug Reactions
BNF : British National Formulary
CEF : Ceftriaxone, Cefuroxime, Cefpodoxime
CI : Confidence Interval
CMEs : Continuous Medical Education
CPE : Continuous Professional Education
CTX : Co-trimoxazole
EMHSLU : Essential Medicines and Health Supplies List of Uganda
HMIS : Health Management Information Systems
HWs : Health Workers
IRB : Institutional Review Board
PCM : Paracetamol
UCG : Uganda Clinical Guidelines
UK : United Kingdom
US : United States
OPERATIONAL DEFINITIONS

**Antibiotics:** Substances derived from microorganisms that can kill or inhibit the growth of other microorganisms. However according to our study, an antibiotic will refer to any antibacterial drug prescribed.

**Pharmacovigilance:** Science and activity of detection, assessment, understanding and alleviating adverse drug effects or any other related drug problems.

**Medication error:** Any preventable event that may lead to inappropriate use of a medicine.

**Dispensing:** The process of preparing and giving of medicines to a given person on the basis of a prescription.

**Dispensing errors:** A discrepancy between a prescription and the medicine that the pharmacy delivers to the patient or distributes to the wards on the basis of this prescription.

**Administration:** The giving out of a therapeutic agent to a patient by inhalation, injection, infusion and orally among others.

**Administration errors:** A gap between drug prescription and administration stages. It involves administering a wrong drug, to a wrong patient in a wrong dose and form by a wrong route at the wrong time in the wrong frequencies amongst others.

**Prescription:** A written/verbal/electronic direction from a licensed practitioner to a pharmacist/nurse for the preparation, compounding, dispensing and administration of a medicine to a specific patient at a particular time.

**Prescription errors:** An error occurring as a result of inappropriate decision making during drug prescribing, improper drug selection, illegible hand writing, use of abbreviations not familiar to other health workers and use of brand names of drugs rather than generic names during drug prescribing.
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ABSTRACT

Background: A medication error is interpreted as an avoidable circumstance which may affect the drug end user while the medication is in his/her custody or even in the care of the healthcare professional. Medication error occurrences have been explored and documented in some parts of Uganda but not in ARRH. And since these errors pose a serious challenge to the health care system, it was worth assessing their occurrence in ARRH.

Objectives: To establish the prevalence of different types of medication errors, drivers of medication errors and hindrances to medication error reporting at the in-patient wards of ARRH.

Methods: It was a descriptive cross-sectional study employing mixed methods. The study was conducted at the in-patient department of ARRH amongst 309 patients and 59 HWs. Data was collected using a semi-structured questionnaire and key informant interview guides. Data was analyzed using the SPSS version 19.0 computer package. Data collected were presented in form of pie charts, frequency tables and bar graphs and summarized into percentages. Qualitative data was presented in form of detailed descriptions.

Findings: Administration errors accounted for majority (57.2%) of the medication errors, followed by dispensing errors (53.1%) and lastly prescription errors (36%). The study results indicated that antibiotics were the category of medicines more prone to incorrect time of drug administration (76.4%) and incorrect frequency of drug administration (93.8%) with a statistical significance of p=0.00 in all scenarios. None of the 309 patient files completely had no medication errors. Drivers to medication errors reported were personal negligence, attitude of health workers, lack of enough reliable knowledge and desire to avoid mistrust significantly hindered medication error reporting with 43 HWs agreeing.

Conclusion: Medication errors are common in ARRH and are most prevalent during drug administration. Negligence is the key factor implicated in medication error occurrence. Desire to avoid mistrust and fear of being rated incompetent amongst HWs has significantly hindered error reporting. Key terms: Medication errors are avoidable occurrences affecting the drug end user. Drug administration errors refers to a discrepancy between what the drug end user received and what the prescriber intended.
CHAPTER ONE

1.0 Introduction

Medical errors pose a serious challenge to the healthcare system globally leading to disastrous events like therapeutic failure, adverse drug reactions, resource wastage due to longer hospital stays and eventually death {Mohanty 2016}. All patients irrespective of their status quo may be exposed to a medical error at any one point in time and no health care system is immune to medication errors. A medical error encompasses medication errors, surgical errors, diagnostic errors, investigative errors and preventive errors. Medication errors are the commonest amongst all the medical errors encountered in a hospital setting {Katongole, Anguyo et al. 2015}.

A medication error is interpreted as an avoidable circumstance which may affect the drug end user while the medication is in his/her custody or in the care of the healthcare professional in a variety of ways, including injuries to the patient and permanent or temporary morbidities {Rodriguez-Gonzalez, Herranz-Alonso et al. 2011}. Medication errors are categorized into prescribing, dispensing and administration errors. The prevalence of medication errors shows that in Taiwan, drug administration was at 25%, erroneous prescribing at 68% and inappropriate dispensing at 7%. However in Spain, drug prescribing was at 39%, transcription at 12%, drug administration at 38% and dispensing at 11% {Tang, Sheu et al. 2007; Rodriguez-Gonzalez, Herranz-Alonso et al. 2011}. In Rwanda, wrong time of administering drugs accounted for 20% and dispensing 7% of the medication errors {Nkurunziza, Chironda et al. 2018}. However in Uganda 18% of the health workers were implicated in medication errors while 41% were able to point out medication errors committed by their colleagues without specifying the individual errors encountered {Nkurunziza, Chironda et al. 2018}.

Medication errors are estimated to be among the top 10 leading causes of global disability amounting to almost 23 million disability-adjusted life years. Further, global estimates indicate that 42 billion US $ are spent on medication errors annually and 251,454 deaths in 2016 were attributable to medication errors, a 62% increment from the year 1990. These estimates could be much bigger than anticipated because of increased rates of underreporting due to increased lawsuits against health workers by patients more especially in the developed countries {Illoh,
Only 31% of the health workers in central Uganda were positive towards error reporting whereas 33% were negative. This justifies the fact that medication errors occur but a few are on record due to unestablished error reporting systems {Nkurunziza, Chironda et al. 2018; Katongole, Anguyo et al. 2015; Kiguba, Waako et al. 2015}. A number of factors contribute towards medication errors inclusive of which are health practitioners’ attention deficit, negligence, unreliable administration, poor organization of medicines within the facility, no adherence to continuous professional development programs and lack of in-place tracking devices {Han and Maxwell 2006; Bates, Cohen et al. 2001}. Antibiotics are the commonly affected drugs regarding medication errors. In India, 22.5% of medication errors involved antibiotics. In Taiwan, 38.9% and 6.9% of medication errors involved antibiotics, analgesics and anti-diabetics{Sheikh, Mateti et al. 2017; Tang, Sheu et al. 2007}. And with the current burden of medication errors, it becomes realistic for us to assess the medication errors that occur during prescription, dispensing and administration of the different classes of medicines.

1.1 Statement of the problem
Medication errors remain a bigger challenge for the developing countries affecting not only the health workers but the patients as well. Every patient is a candidate to medication errors at any one time and no institution is free from medication errors{Tang, Sheu et al. 2007;Mohanty 2016}. Currently, Uganda has only an ADR reporting system with 14 regional Pharmacovigilance centers minus an error reporting system{Kiguba, Waako et al. 2015}. The Ugandan National Pharmacovigilance Center’s mandate was to integrate medication error reporting into ADR reporting systems just like it is in developed countries. However, this only seems to be on paper and not yet in practice {Kiguba, Waako et al. 2015}.

Medication errors can result into a number of negative outcomes such as preventable injuries to patients, prolonged hospital stays, patient death, loss of integrity in the health care system, legal claims against health workers, and emergence of antibiotic resistance {Adegboyega 2018}. 
Estimation of medication errors in the developing countries is quite complex because of poor documentation, absence of proper error reporting systems and limited research in the field of medication errors [Katongole, Anguyo et al. 2015; Joolaee, Hajibabaee et al. 2011]. It is therefore important to assess medication errors that occur during antibiotic use at ARRH so as to derive measures against occurrences of these errors.

1.2 Justification of the study
Error reporting was found to help in the promotion of patient’s safety by pointing out obvious mistakes which arose during drug administration, dispensing and prescription. Error reporting was also found to be useful in minimizing resource wastage both on the side of the patients and the hospital as well.
Besides patients, error reporting enabled health workers offer quality services to patients and avoid error re-occurrence.
The study findings therefore are to help healthcare workers and policy makers to devise measures of mitigating medication errors in order to improve the quality of clinical practice. These measures include continuous medical education programs, employing pharmacists as part of the clinical team at the wards, establishing error reporting systems and disclosure of such errors to patients.
The study findings are to further contribute to the body of existing knowledge as far as academics is concerned and also help generate information for further research.

1.3 Research Questions
What is the prevalence of different types of medication errors at in-patient wards of ARRH?
What are the drivers of medication errors at the in-patient wards of ARRH?
What are the hindrances to medication error reporting at the in-patient wards of ARRH?
1.4 Objectives

1.4.1 General objectives
To assess the prevalence and drivers to medication errors and hindrances towards medication error reporting at the in-patient wards of ARRH.

1.4.2 Specific objectives
1) To establish the prevalence of different types of medication errors at the in-patient wards of ARRH.

2) To establish the drivers of medication errors at the in-patient wards of ARRH.

3) To determine the hindrances to medication error reporting at the in-patient wards of ARRH.
1.5 Conceptual framework

Figure 1: Conceptual framework

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Drivers of medication errors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Staffing levels</td>
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<td></td>
<td>- Work load</td>
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<td></td>
<td>- Negligence</td>
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<td>- Attitudes and experience amongst others</td>
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</table>

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Medication errors</th>
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<tbody>
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<td></td>
<td>Prescribing errors</td>
</tr>
<tr>
<td></td>
<td>- Under/overprescribing/ineffective prescribing etc.</td>
</tr>
<tr>
<td></td>
<td>Dispensing errors</td>
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<tr>
<td></td>
<td>- Omission, incorrect labeling, inappropriate instructions etc.</td>
</tr>
<tr>
<td></td>
<td>Administration errors</td>
</tr>
<tr>
<td></td>
<td>- Wrong infusion rate, wrong route of administration etc.</td>
</tr>
</tbody>
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<table>
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<tr>
<th>Error outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Prolonged hospital stay</td>
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<tr>
<td>- Resource wastage</td>
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<tr>
<td>- Suing of hospital staff</td>
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<tr>
<td>- Loss of trust in hospital staff</td>
</tr>
<tr>
<td>- Increased mortality rates</td>
</tr>
<tr>
<td>- Increased antibiotic resistance among others</td>
</tr>
</tbody>
</table>
Explanation of the conceptual framework

The above framework is our own idea of the entire study compiled based on our review of the various studies by other authors about medication errors.

The independent variable also called predicting variables will lead to medication errors (a dependent variable) unless they are being controlled and the medication errors will henceforth result into negative outcomes. Independent variables such as understaffing, inadequate experience, health worker’s negligence, poor attitude towards error reporting, lack of feedback to health workers on reported errors, fear for error disclosure, and misunderstanding within healthcare professionals will result into medication errors which will thus result into increased rates of antibiotic resistance, prolonged hospital stays and resource wastage.
2.1 Prevalence of different types of medication errors.

In the medical setting, commonly occurring medication errors include prescription errors, dispensing errors and administration errors. However prescription and administration errors are the commonest. Children (31%) are more often affected by medication error consequences as compared to the adults (13%) \{Sears, Ross-White \textit{et al.} 2012\}.

In developed countries, growth in technology has seen great decline in medication errors. These technologies include utilization of computerized physician order entry systems and computerized robotics, bar-code medication administration/verification, the use of computerized smart pump infusion devices and the automated dispensing systems \{Maurer, 2010\}.

2.1.1 Prescription errors

A prescription refers to an order from a medical practitioner that authorizes a patient to be issued with a medicine or treatment. A prescription can be written or electronic and must be authenticated by an authorized personnel who appears to be a licensed practitioner such as a veterinary doctor, dental surgeon, physician, midwife to mention but a few. A good prescription must be legible and have a superscription, inscription, subscription, signature, refill information and the physician’s signature. Prescription errors arise due to improper drug selection, illegible hand writing, use of abbreviations not familiar to other health workers, use of brand names of drugs rather than generic names during drug prescribing. Utilization of computerized physician order entry systems over hand-written prescribing in developed countries like Canada has greatly reduced the number of medication errors per patient\{Sheikh, Mateti \textit{et al.} 2017; Aghakouchakzadeh, Izadpanah \textit{et al.} 2017; Alsulami, Conroy \textit{et al.} 2013\}. Prescribing errors in Taiwan account for 10% of the medication errors \{Tang, Sheu \textit{et al.} 2007\}.
(i) **Brand name versus generic name ideology**
Of late, prescription errors are a leading cause of hospital associated mortality and morbidity. Currently the health care system has been overwhelmed with multiple brand names of the same generic drug causing a lot of confusion amongst prescribers hence leading to prescription errors. At times, prescriptions can be ambiguous having drug name initials such as (CTX,PCM,CEF) rather than their full precise names which though may sound-alike, could apply to different medications altogether, for-example CEF could either mean ceftriaxone, cefpodoxime proxetil or cefuroxime axetil henceforth creating more confusion for the drug administrators {Peth, 2003; Sears, Ross-White et al. 2012; Tang, Sheu et al. 2007}.

(ii) **Under-prescribing, Ineffective prescribing and Over prescribing.**
Under-prescribing refers to omission of a drug that is indicated for a given ailment as a result of it being absent or due to the prescribers’ negligence. Health workers more so junior doctors do under-prescribe drugs due to lack of sufficient knowledge on how to calculate patient doses, fear for drug interactions and failure to relate elderly drug doses {Aronson, 2009}.

In contrast to under-prescribing, ineffective prescribing refers to recommending an ineffective drug for a given ailment. And ineffective prescribing can be as a result of poor quantification of patient drug needs. Health practitioners who work in resource limited settings tend to comprise patient therapy by under-dosing or resorting to available alternatives which may be inappropriate for a given ailment hence increasing on the chances of medication errors occurring. Over-prescribing refers to giving out drugs to patients in excess or more than necessary for an exaggerated duration even in situations where no drug is needed. Over-prescribing was seen in more than 10% of the elderly persons in the UK {Aronson, 2009}. Over-prescribing culminates into increased ADRs and drug interactions and is common amongst rural clinicians as compared to those in urban settings {Aronson, 2009}.

2.1.2 **Dispensing habits**
Dispensing of medications refers to the preparation, packaging, labeling, record keeping and giving out medicines to either a patient or the person in charge of administering the medicine to the patient. In the United States, the process of drug dispensing to the patient involves a circle of 30-40 steps which indeed augments medication errors. In Canada, out of 10,778 medication
orders, 616 medication errors occurred and in Iran dispensing errors were between 11.3% to 33.6%. Dispensing errors include drug omissions, dispensing out excess/less drugs, dispensing out a drug to the wrong patient, dispensing out a wrong drug to the right patient, incorrect labeling of drug dispensing packs and inadequate information about the use of the medications. In the Ugandan settings however, there is limited information so far recorded about dispensing errors thus a gap that needs further research {Sears, Ross-White et al. 2012; Pazokian, Zagheri Tafreshi et al. 2014}.

2.1.3 Administration errors
Drug administration errors refers to a gap between drug prescription and administration stages. Drug administration errors include failure to give a medication to the patient at the right time and in the correct frequencies (16.6% occurrences), and improper control of the flow of an intravenous infusion (12.8% occurrences) {Carlton and Blegen 2006} Other administration errors include wrong dosage form of the drug, wrong reconstitution and dilutions, wrong duration of treatment, wrong route of drug administration and wrong drug for a given patient. In Taiwan, administration errors accounted for 40% of the medication errors {Tang, Sheu et al. 2007}. In Iran, administration errors ranged between 14.3% to 70.0%, {Pazokian, Zagheri Tafreshi et al. 2014}.

Most of these errors are due to lack of a standardized protocol, environmental stresses, lack of concentration, inadequate knowledge about the drug in question and insufficient knowledge about the patient {Rodriguez-Gonzalez, Herranz-Alonso et al. 2011; Sheikh, Mateti et al. 2017}.

Administration errors normally occur after the dispensing and prescribing stages. The main culprits to administration errors are the nurses who sacrifice up to 40% of their patient care time for patient care multi-tasking in a number of activities. Drug administration being the last stage in the treatment process is more often left unchecked thus accounting for most of the obvious errors {Tang, Sheu et al. 2007; Stratton, Blegen et al. 2004}. By observing the five rights of drug administration which involve attending to the diagnosed patient at the intended time while administering the right dose and drug via the most appropriate route, nurses can avoid up to 50% of the medication errors {Joolaee, Hajibabaee et al. 2011}. 
Previously, the commonly encountered routes of drug administration included peroral, intramuscular, intravenous and hypodermal. However, multiple routes of drug administration have emerged including the use of central venous pressure lines, intra-articular, intradermal route and subcutaneous routes. These multiple routes coupled with the new computerized drug administration techniques have increased the chances of occurrence of drug administration errors. For example the intra-thecal route of drug administration resulted into more than 10 incidents of death/paralysis in persons below 12 years of age in the year 2000 {Tang, Sheu et al. 2007; Aronson, 2009; Choo, Hutchinson et al. 2010}.

2.2 Hindrance to medication error reporting.

In spite of the fact that all health workers are sufficiently trained in the practice of medicine, the number of medication errors is skyrocketing. This trend is attributable to having so many drugs on the market of which only a few are familiar to the practitioners {Peth, 2003}. Medication errors and their causes cannot fully be understood unless these errors are being reported. Various factors have been implicated in hindering error reporting. Among these are lack of health practitioner’s protection against litigation, nature of the reporting protocols, system and people failures, relationship between health workers and attitude of health practitioners towards error reporting.

2.2.1 Lack of health practitioner’s protection against litigation

In 2015, 59% of the American physicians were involved in medical litigation, an increase from 42.2% in 2010 {Iloh, Chuku et al. 2017}. A number of nurses failed to disclose medication errors because they were afraid of the manager’s reactions (77%), responses of fellow workers (61%) and 53% were merely unbothered about medication errors {Maurer, 2010}.

In order for health practitioners to promote patient safety on wards rather than living in fear of medical litigation, health managers should set up a system of error reporting that is punishment free and motivate error reporting through giving out incentives to health practitioners who are faithful to report errors. Incentives can be in the form of performance appraisals and recommendation for career progress among others {Nkurunziza, Chironda et al. 2018}. 
2.2.2 Nature of the reporting protocols
Medication errors can have a major impact on the healthcare system and so error identification and reporting can be of significant help in alleviating them. Nurses in the US only report a medication error when they feel they will not be singled out and penalized for its occurrence {Maurer, 2010}. Error reporting is a cumbersome process entailing error recognition, assessing the need to report, preparing an incident report, follow-up by the responsible administrative body and receiving the error report feedback which discourages many health workers from attempting to report an error occurrence {Maurer, 2010}.

In Jordan, medication errors are underreported because a number of nurses (16%) are ignorant of what to grade as a medication error and 14% are not sure what time is appropriate for error reporting {Mrayyan, Shishani et al. 2007}.

2.2.3 Lack of error reporting technology
Medication error reporting systems in Malaysia include the Quality Assurance Program, Incident Reporting, Daily log book, Pharmacy statistics and verbal reporting {Samsiah, Othman et al. 2016}. The daily log book however is available in Uganda as well, giving more reason for this study to be carried out so as to ascertain why medication errors remain underreported in the country{Kiguba, Waako et al. 2015}.

2.2.4 Relationship between health workers
It is recognized that health workers who easily communicate with each other have increased chances of revealing medication errors to each other and hence learn from them. In Malaysia, scolding of health workers who reported medication errors scared off those who intended to report other such errors{Karavasiliadou and Athanasakis 2014}. A number of doctors and pharmacists in Malaysia perceived the culture of blame being a significant barrier to error reporting as compared to workload, and believed that the percentage of errors reported was far below that observed. However in Malta, 37% of the nurses instead perceived work overload being a lead predisposition factor to medication errors alongside illegible handwriting. A good relationship between health workers saves the organization challenges of medication errors
because pharmacists are able to contact back the physicians on unclear hand written prescriptions {Petrova, Baldacchino et al. 2010}.

2.2.5 Attitude of health practitioners towards error reporting
In Saudi Arabia, 79% of the errors among nurses weren’t reported at all despite their occurrence {Samsiah, Othman et al. 2016}. It was much easier for pharmacists to report medication errors than the doctors and nurses, more so if the errors had resulted into avoidable complications. In Nigeria, physicians were in support of disclosing off medication errors though in clinical practice, none of them disclosed off such errors {Iloh, Chuku et al. 2017}. Physicians in Dubai (74%) had a negative attitude towards disclosing off medication errors that resulted into fatal injuries to the patients {Zaghloul, Rahman et al. 2016}. Physicians would only disclose medication errors to patients if they were pretty sure that there would be no litigation and a conducive hospital blame free culture was availed to them to carry out error reporting {Kiguba, Waako et al. 2015; Cohen, 2000}.

2.3 Drivers of medication errors.
Medication errors are as a result of numerous factors categorized into organizational and individual factors. All these factors would be avoided if set measures for error recognition had been installed. Organizational factors include lack of an error reporting culture, desire to maintain a professional relationship, culture of blame and inaccessibility of a feedback report to health workers, fear of superiors’ and co-workers’ responses, fear of being rated incompetent and getting a low appraisal mark and absence of an active continuous professional development program. Among the organizational factors, work load, lack of motivational factors and policies to reinforce error reporting are too regarded amongst others as major contributing factors to these errors {Karavasiliadou and Athanasakis 2014}.

2.3.1 Individual factors.
To error is human and a number of misnomers such as miscommunication amongst health workers and patients, misreading of drug labels, miscalculation of patient doses, non-adherence to the patient five rights (right drug, right dose, right route, right time and right patient), inability to cross-check patient drugs and their clinical condition and illegible prescriptions can predispose
to medication errors {Karavasiliadou and Athanasakis 2014}. Most of the health workers are aware of medication error occurrences but they only realize their mistakes most times after they have already occurred. Individual factors such as health worker’s negligence and practitioners’ attitudes and experience are commonly associated with medication errors.

i) Health worker’s negligence.

A number of medication errors occur because health workers are merely inattentive while attending to patients. Reluctance of health practitioners in Addis Ababa has resulted into a significant increment in medication errors {Maurer, 2010}. These medication errors are committed as a result of erroneously choosing a wrong drug, a wrong dosage form, misinterpreting abbreviations, making wrong calculations for pediatric and elderly drug doses and failure to differentiate between a decimal point and a zero {Maurer, 2010}.

ii) Practitioners’ attitudes and experience

Patient care becomes quite easier requiring less effort when the same physician follows up a patient till he/she is discharged. However in our current settings with the different working schedules, this is quite impossible and patient-physician exchanges can triple up the chances of medication error occurrences when it comes to history taking and creating a rapport with the patient/patient attendants. There is need for practitioners to be well conversant with most medical conditions as well as the different medications on the market based on their color, size, shape and strength since most patients tend to remember their daily medications by these particulars which may sound quite confusing to a number of practitioners who may be freshly from college {Peth, 2003}. There is a general lack of prescription information in a number of hospital settings in the developing countries {Negash, Kebede et al. 2013}. Even those settings that claim to have the information guidelines do not adhere to them despite their knowledge of medication errors {Negash, Kebede et al. 2013}. 
2.3.2 Organizational factors

i) Lack of in-place monitoring techniques.

A number of developed countries have adopted the e-prescription in order to avoid prescription errors that stem from illegible handwriting. However in the developing countries where such technology is unaffordable, the only mode of error elimination that needs to be adopted is to make standard prescription and administration sheets, standard treatment protocols and a systematic cross-check of prescriptions and transcriptions by clinical pharmacists {Negash, Kebede et al. 2013}.

ii) Hospital-related workload (patient load versus staffing levels).

In sub-Saharan Africa, the ratio of patient to health worker is not directly proportional meaning most health workers are overworked and have few off-duty periods. For example, the Ethiopian doctor-to-patient ratio is almost at 1:20,000 whereas nurse-to-patient ratio at 1:3,000 {Negash, Kebede et al. 2013}. Coupled with poor working conditions, there is an increased risk to medication errors. The desire to complete work in time, long waiting lines and interruptions of health workers by other staff or even patients creates cumulative pressure on health workers making them more anxious and so prone to errors {Rogers, Hwang et al. 2004; Nkurunziza, Chironda et al. 2018; Tang, Sheu et al. 2007}. At the state general hospital in Malta, medication errors were commonly reported on medical wards than the rest of the wards because of multiple in-patient admissions {Petrova, Baldacchino et al. 2010}.

iii) Inadequate exposure to CPE programs.

In Rwanda, 33.6% of the health care professionals have never received any seminars more so on the newly invented medications despite their surge onto the market. The FDA report on medication errors in Rwanda indicate that low knowledge levels (44%) has played a key role in medication error occurrences {Nkurunziza, Chironda et al. 2018}.

In Malaysia, health workers were anxious to receive more training on medication errors and its reporting through continuous professional development programs {Samsiah, Othman et al. 2016}. Evidence shows health workers’ willingness to report medication errors once it becomes clear to them, what they are, how they occur and the protocol used in reporting such errors {Samsiah, Othman et al. 2016}. 
iv) **Number of medications available to be prescribed.**

Currently, medication errors are being blamed onto the mushrooming brand names of drugs on market due to an increment in the available pharmaceutical companies. A few medications were available in 1961. However in 1995 the number rose up to over 8000 medications having more than 17000 brand and generic names (Tang, Sheu *et al.* 2007). As the number of medications increase, so are the routes of drug administration. Originally the commonest route of drug administration was peroral. Today, there are many routes of drug administration including intramuscular, intravenous, subcutaneous, hypodermal, intranasal, sub lingual, rectal, intravaginal and intrathecal, among others. All these innovations make decision making as regards patient care a complex process thus increasing the chances of medication errors (Tang, Sheu *et al.* 2007).
CHAPTER THREE

3.0 Methods

3.1 Study design
It was a descriptive cross-sectional study employing mixed methods of data collection.

3.2 Study setting
The study was carried out at ARRH located approximately 480Km Northwest of Kampala the capital city of Uganda. The coordinates of Arua Regional Referral Hospital are Latitude:3.019444; Longitude:30.912500. ARRH is a government institution with a bed capacity of 400. It serves patients within Arua district and other districts such as Koboko, Yumbe, Adjumani, Moyo, Maracha, Zombo, Pakwach, Nebbi, as well as the neighboring parts of Southern Sudan and Democratic Republic of Congo. The hospital offers primary, secondary and tertiary health care services besides research and teaching services. Services offered by the hospital are free of charge except for a small section of the private wing which is for paying patients only. The study was carried out in the four main wards of the hospital (medical, surgical, pediatric and gynecology) [Ministry of health].

3.3 Study population
The study respondents included in-charges of wards, medical superintendant, head of medicines and therapeutics committee, hospital pharmacist, general doctors, nurses, dispensers and interns (doctors, nurses and pharmacists). Patients.

3.4 Selection criteria

3.4.1 Inclusion criteria
The study included all medical workers who were present at that time.

All patients present at the wards were also included in the study.
3.4.2 Exclusion criteria
The study excluded all health workers who had just worked at the hospital for less than 2 months.

3.5 Sampling Procedures
Non-probability sampling methods (purposive and convenience) were used to sample health workers.

Purposive sampling technique was used to select key informants (the medical superintendent, ward in-charges, head of medicine and therapeutics committee, the senior nursing officers and the hospital pharmacist) for the qualitative interviews.

A convenience sampling technique was used to select health workers and only those accessible at the work station during the study period were recruited into the study. This formed the quantitative part of the research. This sampling technique was adopted from a similar study conducted by Nkurunziza, Chironda et al. (2018) in Rwanda.

3.6 Sample size determination

<table>
<thead>
<tr>
<th>Table 1: Sample size of HWs for the qualitative study</th>
</tr>
</thead>
<tbody>
<tr>
<td>General doctors</td>
</tr>
<tr>
<td>Intern practitioners (doctors, pharmacists, nurses)</td>
</tr>
<tr>
<td>Nurses</td>
</tr>
<tr>
<td>Dispensers</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2: Sample size of key informants for the qualitative study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical superintendant</td>
</tr>
<tr>
<td>Ward in-charges</td>
</tr>
<tr>
<td>Head of the medicine and therapeutic committee</td>
</tr>
<tr>
<td>Hospital pharmacist</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>
The sample size for the quantitative study was based on the estimated number of health workers at the wards. And since the number was such small, we decided to use it as a whole without calculating the sample size {ARRH records department}.

Sample size for patients:

Determined using a sample size formula by Kish Leslie (adopted from lecture notes by professor Joan Kalyango) for cross-sectional studies

\[ N = \frac{Z^2 \alpha \ p (1- p)}{d^2} \]

also adopted from a similar study in India by Sheikh, Mateti et al. (2017)

Where \( N \) = desired sample size of patient files.

\( p \) = assumed true population prevalence of patient prescriptions with medication errors which is 0.52{Sada, Melkie et al. 2015} and \( 1- p \) = the probability of patient prescriptions having no medication errors which becomes; \( (1-0.52) = 0.48 \)

The value of \( p \) was estimated based on findings from a related study in Ethiopia, Addis Ababa about medication prescribing errors by Sada, Melkie et al. (2015). This was because Uganda and Ethiopia are both developing countries within sub-Saharan Africa where the rate of medication errors is still underestimated.

\( Z\alpha \) = Standard normal deviation at 95% level of confidence which is 1.96

\( d \) = Absolute error between the estimated and true population prevalence of 5% (margin of error). Calculated sample size \( N = 1.96 \times 1.96 \times (0.52 \times 0.48) \times 0.05^2 = 384 \) patients which were approximately the number of patient files.

Using the modified Kish Leslie formula for a finite population, the adjusted sample size was:

\[ S = \frac{N}{1 + (N - 1)/K} \]

(adopted from lecture notes by Dr.Anyama Nobert), where \( K \) = estimated number of patients in ARRH which was at 1602. These statistics were based on the HMIS reports for the month of October for medical (132), surgical (240), pediatric (510) and gynecology wards (720) {HMIS reports for the month of October}.

Hence \( S = 384/[1 + (384 - 1)/1602] = 309 \) patients.
Of the 309 patients, 25\((132/1602)\) of the medical ward, 98\((510/1602)\) from the pediatric ward, 138\((720/1602)\) from the gynecological ward and 46\((240/1602)\) from the surgical ward.

3.7 Data Collection Methods

3.7.1 Data collection instruments

- Semi-structured Questionnaire
- Key informant interview guides

3.7.2 Data collection process

A semi-structured questionnaire was used to collect data on the prevalence of both perceived and actual medication errors and the hindrances to medication error reporting.

Key informant interview guide was used to collect data on factors that predispose to medication errors and what could be done to prevent them.

3.8 Study variables

3.8.1 Independent/predictor variables

- Socio demographics
- Drivers of medication errors
- Hindrances to error reporting

3.8.2 Dependent/outcome variables

- Medication errors; Prescription errors
  - Dispensing errors
  - Administration errors
Data management

Data collection tools were reviewed at the end of each interview and questionnaire administration for completeness and accuracy to ensure a complete data set for analysis. A database was set up using the Epi-info software [Centers for Disease Control and Prevention, Atlanta, Georgia (US)].

Data analysis

Data analysis was done using the SPSS (statistical analysis package for social sciences) version 19.0 computer package {IBM Corporation, Chicago, LLLinois, United States}.

Quantitative data

Socio demographics, drivers and prevalence of medication errors and hindrances to error reporting were analyzed using means and mode.

Data collected about the socio demographics, drivers and prevalence of medication errors and hindrances to error reporting were presented in form of pie charts, frequency tables and histograms.

Categorical data was summarized into proportions and percentages and presented in form of frequency tables, bar charts and pie charts.

Qualitative data: was presented in form of detailed descriptions.

Quality control

The questionnaires and interview guides were pre-tested using at least 10 health workers and 10 patient files in order to get assurance that they were actually complete, accurate and would help in obtaining the desired information.

Data was entered as soon as it was collected so as to avoid recall bias and losing it.
3.10 Ethical Considerations
Approval to carry out the study was sought from the IRB of the School of Health Sciences, Makerere University. The pharmacy department of Makerere University provided us with permission to carry out this research. Further permission was sought from the hospital administration.

Informed consent was obtained from the health workers as well as the patients before they participated in the study.

Confidentiality and privacy to information obtained from the study was observed by ensuring that only the researcher had access to the records. These records were maintained bearing no patient’s identity (for example the name and address of the patient).

And in cases where we came across errors that could negatively impact the patients’ health, we made appropriate interventions.

3.11 Dissemination of the results
The results of the study were presented to the hospital administration. The study findings were used to lay out strategies by the hospital administration on how to minimize medication errors in order to improve patient safety.

The final report was presented to the Department of Pharmacy as a requirement for the award of a Bachelor’s degree of Pharmacy.
4.0 RESULTS
A total of 309 patient files were studied in search of prevalence of medication errors from the four main wards of pediatrics, medical, surgical and gynecology. A total of 59 out of the proposed 67 health workers of different cadres gave responses about hindrances of medication error reporting and the drivers of medication errors.

Majority of the health workers were Christians (93%) while the least number consisted of Muslims (7%). Most of the HWs (61%) were single while 39% of them were married. The largest numbers of respondents for the study were nurses (42%).

The largest numbers of respondents were from the gynecological ward (22) while the least numbers were from the pediatric ward (10).

The majority of the HWs (71%) were between 20-30 years of age as shown below meaning most of them had just completed school and had only worked a few years.
Table 3; Showing the social demographic characteristics of health workers

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-30</td>
<td>42</td>
<td>71</td>
</tr>
<tr>
<td>31-40</td>
<td>05</td>
<td>9</td>
</tr>
<tr>
<td>≥41</td>
<td>12</td>
<td>20</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>36</td>
<td>61</td>
</tr>
<tr>
<td>Married</td>
<td>23</td>
<td>39</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>35</td>
<td>59</td>
</tr>
<tr>
<td>Female</td>
<td>24</td>
<td>41</td>
</tr>
<tr>
<td><strong>Religion</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Christian</td>
<td>55</td>
<td>93</td>
</tr>
<tr>
<td>Moslem</td>
<td>04</td>
<td>07</td>
</tr>
<tr>
<td><strong>Position held</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Key informants</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital director</td>
<td>01</td>
<td>1.7</td>
</tr>
<tr>
<td>Head of medicines and therapeutics committee</td>
<td>01</td>
<td>1.7</td>
</tr>
<tr>
<td>Ward in-charge</td>
<td>02</td>
<td>3.4</td>
</tr>
<tr>
<td>Pharmacist</td>
<td>01</td>
<td>1.7</td>
</tr>
<tr>
<td><strong>Other HWs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General doctors</td>
<td>06</td>
<td>10</td>
</tr>
<tr>
<td>Pharmacy technicians</td>
<td>05</td>
<td>8.5</td>
</tr>
<tr>
<td>Interns</td>
<td>18</td>
<td>31</td>
</tr>
<tr>
<td>Nurses</td>
<td>25</td>
<td>42</td>
</tr>
<tr>
<td><strong>HWs/Ward</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gynecology</td>
<td>22</td>
<td>38</td>
</tr>
<tr>
<td>Surgical</td>
<td>14</td>
<td>24</td>
</tr>
<tr>
<td>Medical</td>
<td>12</td>
<td>21</td>
</tr>
<tr>
<td>Pediatric</td>
<td>10</td>
<td>17</td>
</tr>
</tbody>
</table>
Table 4: Showing the distribution of patient files according to error type and ward.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Frequency (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Medication errors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Administration errors</td>
<td>177</td>
<td>57.2</td>
</tr>
<tr>
<td>Dispensing errors</td>
<td>164</td>
<td>53.1</td>
</tr>
<tr>
<td>Prescription errors</td>
<td>110</td>
<td>36</td>
</tr>
<tr>
<td><strong>Ward</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical</td>
<td>25</td>
<td>8</td>
</tr>
<tr>
<td>Surgical</td>
<td>46</td>
<td>15</td>
</tr>
<tr>
<td>Pediatric</td>
<td>98</td>
<td>32</td>
</tr>
<tr>
<td>Gynecology</td>
<td>138</td>
<td>45</td>
</tr>
</tbody>
</table>

Majority of the patient files (57.2%) were affected by administration errors and the least number by prescription errors (36%). Most of the files reviewed appeared to be from the gynecology ward and the least from the medical ward.

### 4.2 Prevalence of the different types of medication errors

Drug administration errors were common to all the wards as opposed to drug prescribing except in the gynecology ward where prescribing errors appeared higher (71%) than administration errors (39%).
Table 5: Showing the commonly occurring medication errors in the wards of ARRH

<table>
<thead>
<tr>
<th>Ward category</th>
<th>Medication error</th>
<th>Frequency (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgical</td>
<td>Prescription errors</td>
<td>14</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Administration errors</td>
<td>32</td>
<td>70</td>
</tr>
<tr>
<td>Medical</td>
<td>Prescription errors</td>
<td>07</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>Administration errors</td>
<td>22</td>
<td>86</td>
</tr>
<tr>
<td>Gynecology</td>
<td>Prescription errors</td>
<td>98</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td>Administration errors</td>
<td>53</td>
<td>39</td>
</tr>
</tbody>
</table>

Table 6: An illustration of dispensing errors at the pharmacy department of ARRH.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failure to confirm patient’s allergy prior to dispensing</td>
<td>309</td>
<td>100</td>
</tr>
<tr>
<td>Failure to instruct patients on proper medication use</td>
<td>289</td>
<td>93.5</td>
</tr>
<tr>
<td>Failure to crosscheck the medicines against prescriptions prior to dispensing</td>
<td>250</td>
<td>80.9</td>
</tr>
<tr>
<td>Failure to make proper instructions on the dispensing</td>
<td>200</td>
<td>64.7</td>
</tr>
<tr>
<td>Dispensation of less drugs</td>
<td>200</td>
<td>64.7</td>
</tr>
<tr>
<td>Omission of patient drugs</td>
<td>50</td>
<td>16.18</td>
</tr>
<tr>
<td>Dispensation of excess drugs</td>
<td>10</td>
<td>3.2</td>
</tr>
<tr>
<td>Dispensed out drugs to the wrong patient</td>
<td>05</td>
<td>1.6</td>
</tr>
</tbody>
</table>

Failure to confirm patient’s allergic history to medications accounted for the largest number of dispensing errors (100%) while dispensing out drugs to the wrong patient accounted for the least number of errors (1.6%).
Figure 2: A pie chart above shows drugs which are more prone to medication errors.

Antibiotics were ranked number one with 80% amongst drugs prone to medication errors followed by others with 15% and finally analgesics with 5%.

Table 7: Bivariate results of the relationship between the different medication errors and frequently prescribed categories of drugs

<table>
<thead>
<tr>
<th>Drug Category</th>
<th>Medication errors</th>
<th>Odds Ratio (OR)(95%CI)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incorrect time of drug administration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes [n (%)]</td>
<td>No [n (%)]</td>
<td></td>
</tr>
<tr>
<td>Antibiotics</td>
<td>Yes 113 (76.4)</td>
<td>35 (23.6)</td>
<td>9.766 (5.800-16.445)</td>
</tr>
<tr>
<td></td>
<td>No 40 (24.8)</td>
<td>121(75.2)</td>
<td></td>
</tr>
<tr>
<td>Abbreviated drug names</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antibiotics</td>
<td>Yes 107 (83.6)</td>
<td>21(16.4)</td>
<td>17.398(9.712-31.169)</td>
</tr>
<tr>
<td></td>
<td>No 41 (22.7)</td>
<td>140(77.3)</td>
<td></td>
</tr>
<tr>
<td>Incorrect frequency of drug administration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antibiotics</td>
<td>Yes 120(93.8)</td>
<td>08(6.3)</td>
<td>81.964 (36.054-186.338)</td>
</tr>
<tr>
<td></td>
<td>No 28(15.5)</td>
<td>153(84.5)</td>
<td></td>
</tr>
<tr>
<td>Omission of weight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes 94(42.7)</td>
<td>126(57.3)</td>
<td>0.484 (0.293-0.799)</td>
</tr>
<tr>
<td></td>
<td>No 54(60.7)</td>
<td>35(39.3)</td>
<td></td>
</tr>
</tbody>
</table>

** Significance at 5% level
The study results indicate that antibiotics are the commonest category of drugs more prone to incorrect time of drug administration (76.4%) and incorrect frequency of drug administration (93.8%) with a significance level of $p=0.00$ in all scenarios.

4.3 Drivers to medication errors

4.3 (i) Responses from the key informants (medical superintendent, head of medicines and therapeutics committee, hospital pharmacist, ward in-charges of pediatric and medical wards).

a) Individual factors

These included; personal negligence which goes hand in hand with attitude of health workers.

Lack of enough reliable knowledge which may be due to low experience and poor communication/relationship amongst health workers,

Some HWs get exhausted doing the same activity repeatedly hence predisposing to medication errors and at times patients may want to be worked upon immediately hence putting the HWs on pressure,

Certain HWs prefer a given medication yet at times the diagnosis may be different and so they may end up confusing themselves in the process. This has been attributed to incentive giving by the ever increasing numbers of pharmaceutical companies.

b) Organizational/institutional factors

These include; understaffing of the hospital as well as departmental wards,

Lack of motivation of the HWs though to a lesser extent,

Having a wide range of similar drugs on the market which creates confusion and inadequate trainings amongst health workers.
4.3 (ii) Suggested remedies from key informants to reduce medication errors.

There is need to follow-up and supervise health care givers while at work and encourage peer-supervision. Follow-up should be done by the respective ward in-charges. Train health workers to regularly consult from each other on key matters. Update health workers with new and current information and encourage them to use the available literature while prescribing drugs. Medical auditing programs need to be put in place and also increase on the man power to capture the problem of work overload. Motivate health workers by increasing on their salaries to enable them take work seriously. Put in place standard operating procedures as regards drug prescription steps, drug administration and patient clerkships.

4.4 (i) Hindrances to medication error reporting

Desire to avoid mistrust significantly hindered medication error reporting with 43 (79.6%) HWs agreeing and only 11 (20.4%) HWs disagreeing which was followed by 41 (75.9%) HWs agreeing to fear of being rated incompetent and only 13 (24%) of them disagreeing. Fear for negative outcomes of errors and fear to be blamed were reported with 39 (72%) HWs agreeing and only 15 (28%) disagreeing. Fear for reactions from the top administration and lack of error reporting system all affected error reporting equally with 36 (66.7%) HWs agreeing and 18 (33.3%) of them disagreeing. Most HWs 29 (53.7%) disagreed that failure to know what to categorize as an error can be a hindrance to error reporting.
4.4 (ii) Suggested remedies from HWs to step-up medication error reporting.

Educating healthy workers on the importance of reporting medication errors and protecting health workers from litigation.

Clearly elaborating the channels to be followed while reporting medication errors.

Installing in place a strong monitoring system and reporting system for errors with error reporting tools plus setting up a medical audit in the wards.

Figure 3; above is an illustration of hindrances to medication error reporting
Reporting of medication errors should be implemented as it has been done for case reports and monthly reports. Individuals at the dispensing department need to be able to call and inform clinician’s in-case of an error encountered.

Introducing a system of incentives for health workers to enhance reporting and avoid the blame game.
CHAPTER FIVE

DISCUSSION OF RESULTS

5.0 Introduction
This chapter summarizes the study outcomes.

5.1 Demographic information of the health workers
The study did not show any relationship between socio-demographics of the health workers and the occurrence of medication errors at the hospital.

5.2 Prevalence of medication errors
At ARRH, administration errors accounted for (57.25%) and dispensing errors (53.1%) as the commonest with prescription errors being the lowest (35.7%). This contradicts with a study done in Canada where prescription and administration errors were the commonest (Sears, Ross-White et al. 2012).

According to Tang et al. 2007, in Taiwan, drug administration was at 25% a figure lower than that in ARRH which was at 57.25%. Erroneous prescribing was at 68% in Taiwan a figure higher than that in ARRH which was at 35.7% meaning HWs in Uganda involved in drug prescribing are more careful than those involved in drug administration. Rodriguez-Gonzalez et al. 2011, during their survey in Spain reported that drug prescribing was at 39% a figure higher than that in Uganda (35.7%) whereas drug administration (38%) and dispensing (11%) were far lower than those in ARRH.

On average, most errors were found to be in the gynecology ward (53.42%), followed by the surgical ward (39.78%), then the medical ward (39.6%) and lastly the pediatric ward (19.24%).

And omission of patient weight as an error is highly associated with drugs such as antibiotics as compared to other drugs which are statistically insignificant. The statistical significance as relates to antibiotics is [OR=0.484, 95%CI: 0.293-0.799, p=0.00]. This is because antibiotic are the commonly utilized drugs.
5.2.1 Prescription errors

Patient information

Patient admission date, name and age were well documented by prescribers in all the wards. The only patient information that was not up to date was patient weights which were completely omitted in medical, surgical and gynecology wards (77.6%) because of an assumption that those wards were for adults. However the weights were well measured and documented for the pediatric ward. Patient weights are crucial especially for children where doses of drugs are calculated per kg body weight unlike for adults except for some drugs which are dosed per kg body weight such as artesunate injection. If the patient weights are not measured and documented in such cases it might lead to either under dosing or overdosing ultimately resulting in medication errors.

(i) Preference to brand names and abbreviations while prescribing medications

The use of brand names while prescribing medications to patients accounted for 9.3% in the four wards, such brand names used included TRAP, NOVOTAX, and ZAHA. The use of abbreviations and drug name initials such as CEF, PCM, and CTX accounted for 35.9% of the errors. This correlates with a study done in Canada and Taiwan where multiple brand names and abbreviations caused confusion amongst prescribers, dispensers and nurses leading to errors (Sears, Ross-White et al. 2012 and Tang, Sheu et al. 2007). Antibiotics are the commonly affected drugs when prescribing while abbreviating (83.6%) with [OR=17.398, 95%CI: 9.712-31.169, p=0.00] whereas the rest of the medications show no statistical significance. Antibiotics show most abbreviation-related errors because most conditions show a need for them. The use of brand names and abbreviations was a common practice amongst intern doctors and clinical officers since they were facilitated and motivated to do so by the upcoming pharmaceutical companies as a way of promoting their products on the market. The problem with using abbreviations and brand names is that not every health professional is familiar with them especially the nurses and dispensers who may end up either omitting the drugs or mistaking them for similarly related drugs leading to errors.
(ii) Overprescribing {polypharmacy}

Overprescribing in ARRH accounted for 4.58% of the prescription errors which is quite lower as compared to the UK where over-prescribing was seen in more than 10% of the elderly persons as reported by Aronson, 2009. Overprescribing may psychologically tune the patient to think they are being treated in the most appropriate way possible not knowing the ADRs and drug interactions that come along with polypharmacy. Polypharmacy was again a common practice amongst intern doctors and clinical officers who tend to prescribe a lot of antibiotics for managing the same condition due to the excitement of being new in practice and wanting to please patients who often feel by being given so many drugs they are well managed. The polypharmacy pattern amongst the interns and clinical officers also shows their insufficient knowledge about the dangers of the practice.

(iii) Illegible handwriting

This was a very common problem in all the wards at about 58.4% and it was one of the leading causes of errors whereby most prescribers were reluctant to write well and instead blamed it on work overload. This has been a problem mostly for those involved in dispensing and administration of drugs as they end up misreading the drugs and also obtain wrong doses and frequencies of the drugs as well. This finding was in agreement with a study done by Sheikh, D et al 2017, on assessment of medication errors in a tertiary care hospital in Taiwan where illegible handwriting was one of the main causes of prescription errors. The poor handwriting amongst the doctors has been trending since most of them believe by so doing they are superior to other health professionals and do not want patients to be able to read whatever is written.

5.2.2 Dispensing errors

The dispensing errors were at 53.1% on average and the second largest errors after administration errors. However this number still remains high when compared to studies in Iran (33.6%) and Canada (5.7%) by Sears, et al. 2012 and Pazokian, et al. 2014 where the process of drug dispensing involves a cycle of 30-40 steps all in the names of minimizing risks to errors. Confirmation of patient allergy history prior to dispensing was not done completely, failure to provide proper instructions on medication use was at 93.5%, failure to cross-check prescriptions against medicines before dispensing at 80.9%, not making directions on dispensing packs and
dispensing less drugs were at 64.7% each. These errors were attributed to work overload coupled with language barrier amongst most of the dispensing staff who were not locals from the region. Majority of the dispensers generally had poor attitude towards learning the local languages and hence could not explain to the patients in detail how to use their drugs or make further inquiries from patients other than just mentioning the quantity and frequency of medications to be taken. However language barrier was not believed to be so much of a problem since the patients from the wards were meant to pick mostly parenteral drugs and a few oral drugs from the pharmacy to be administered by the nurses at wards. The nurses were expected to be able to provide the missing information from the pharmacy being the last HWs to interact with the patients. This wasn’t the right thing to do since the nurses also had a lot of work to do and besides, they lack adequate information about the drugs to give to the patients like the pharmacy personnel would do.

5.2.3 Drug administration errors

Based on studies conducted in Taiwan by Tang, et al. 2007, drug administration errors were quite lower (40%) than those observed in ARRH (57.25%). This is explained by the fact that most drugs run out of stock due to the large numbers of patients being attended to at the hospital and as a result the patients have to incur expenses of purchasing medicines and some sundries needed for administration from their pockets. This is made difficult by the fact that most Ugandans can’t afford the medical bill for a complete treatment to be administered as appropriate and so may end up having medications administered at the wrong times (61%) and in the wrong frequency (53%). In Rwanda, wrong time of administering drugs accounted for 20% of the medication errors as reported by Nkurunziza et al. 2018 which is 1/3 of that from ARRH (61%). Carlton and Blegen 2006, stated that in California, incorrect time and frequency of drug administration accounted for 16.6% of administration errors which is just 1/3 of the occurrences in ARRH.

The drugs that fell a victim of wrong time and frequency of administration were those that are administered 6 hourly such as benzyl penicillin, ampicillin, cloxacillin, ampiclox and metronidazole administered 8 hourly. The antibiotics which are administered once daily such as ceftriaxone didn’t so much succumb to wrong time and frequency of administration. Wrong time
and incorrect frequency of administration of antibiotics is particularly a problem as it perpetrates antibiotic resistance which is currently a big threat worldwide.

**Classes of drugs more prone to medication errors**

In India and Taiwan, antibiotics accounted for 22.5% and 38.9% of the medication errors as reported by Sheikh, *et al.* 2017 and Tang *et al.* 2007 respectively. While in ARRH, it was at 80% a figure much higher than in the two countries. However, medication errors due to analgesics was lower in ARRH (5%) compared to 6.9% in Taiwan. Antibiotics are the commonest category of drugs more prone to incorrect time of drug administration (76.4%), incorrect frequency of drug administration (93.8%) as compared to analgesics and others [sedatives and hypnotics] which are statistically insignificant. The statistical significance for antibiotics is [OR=9.766, 95% CI: 5.800-16.445, p=0.00; OR=81.964, 95%CI: 36.054-186.338, p=0.00; as per the respective errors].

This is because antibiotics are the commonly prescribed class of drugs for the various bacterial infections which are responsible for most of the disease conditions at the hospital. In contrast to antibiotics, sedatives and hypnotics accounted for 15% and analgesics accounted for 5%. Sedatives and hypnotics (diazepam and Phenobarbitone) were particularly a problem in the pediatric ward.

**5.3 Hindrances to medication error reporting**

**5.3.1 Lack of an error reporting system**

Most healthworkers (66.7%) agreed that there were no established systems for reporting errors at the hospital despite the presence of the daily dispensing log book one of the error reporting systems. The study points to the fact that the problem to error reporting could be due to failure to identify what constitutes an error and what doesn’t since 40.7% of the health workers agreed to this fact and so lack of sufficient error reporting systems is just secondary and not the main problem hindering error reporting in ARRH. Despite the presence of the dispensing log book, it carries no meaning if one can’t easily locate an error in it. This study is contrary to a study by Kiguba *et al* 2015 where the health workers pointed out that the dispensing log book was not in existence at the hospital at the time of the study.
5.3.2 Lack of health practitioners protection against litigation
Lack of protection against litigation was one of the hindrances to error reporting as reported by 59.2% of the healthworkers in ARRH. This study correlates with the one done by Peth, 2003 in Columbia on medication errors in the emergency department where lack of health practitioner’s protection against litigation was implicated as a hindrance to error reporting. And according to Kiguba et al 2015 and Cohen, 2000, health workers would only disclose errors if they were pretty sure that there would be no litigation.

5.3.3 Blaming of health workers by the top administration
About 72.2% of health workers reported this as a hindrance to error reporting. This finding is in agreement with what doctors and pharmacists in Malaysia perceived as the culture of blame being a significant barrier to error reporting as compared to workload. Karavasiliadou and Athanasakis 2014. Cohen, 2000, in the US, also discovered that a conducive hospital blame free environment would encourage health workers to report medication errors without fail hence being in agreement with the study in ARRH.

5.3.4 Fear of responses from fellow health workers and reactions from the top hospital administration.
63% of the health workers believed that failure to report errors was due to fear of responses from fellow colleagues and 67% attributed failure to reporting to being afraid of reactions from top administration. These figures closely relate with that reported by Maurer, 2010, in a study on nurse’s perceptions and experiences with medication errors whereby 77% of nurses failed to disclose errors for fear of the manager’s reactions and 61% for fear of responses from fellow health workers. In Malaysia, Karavasiliadou and Athanasakis, 2014 discovered that scolding of health workers who reported medication errors scared off those who had intentions of reporting such errors.
5.4 Drivers to medication errors

5.4.1 Individual factors

a) Individual factors

Negligence and attitude of the health workers.

The key informants reported negligence and poor attitude of HWs as an issue mainly responsible for the occurrences of medication errors at the hospital. Many health workers do not take responsibility for their actions and do not make patient care a priority and as a result they just do work because they are supposed to so as to earn a living. They therefore end up committing errors by choosing wrong drugs, doses and misinterpretation of prescriptions. These findings correlate with a study conducted in Ethiopia, Addis Ababa amongst nurses where health workers were discovered to be reluctant and inattentive while providing health care services to patients that ultimately resulted in increment of medication errors (Maurer, 2010)

Insufficient knowledge amongst HWs.

Low experience levels amongst interns and newly qualified health professionals who probably haven’t had enough exposure to different medications during their training plays a key role in error occurrence. Some HWs lacked enough information on the administration of certain drugs which was mainly attributed to the fact that some individuals do not admit that health practice is an ever changing field where health workers need to stay up-dated with the current changes by upgrading and getting involved in further studies. Knowledge gap was also emphasized in a study conducted by Nkurunziza et al 2018 where low knowledge levels (44%) has played a significant role in errors in Rwanda. Negash, et al. 2013, emphasized the need for practitioners especially those fresh from college to be well conversant with the common medical conditions and the different medications on market so as to eliminate medication errors.

Poor communication/relationship amongst health workers.

Many HWs do not relate so well with their colleagues and as a result when an error has been made for example by a prescriber, a pharmacy personnel or nurse may fail to communicate to the prescriber responsible for such an error. In addition there are no properly established
communication channels at the hospital. Petrova et al 2010 reported that a good relationship between HWs saves the organization challenges of medication errors.

**5.4.2 Organizational factors**

**Understaffing of the hospital’s various wards**
The hospital has an ever increasing number of patient admissions and yet the number of HWs stayed constant, this has greatly contributed to errors which was evident in the gynecology ward that has the highest number of admissions and the greatest percentage of errors (53.42%). The few health workers end up being over worked and therefore are more prone to making errors. This finding is backed up by a study done in sub-Saharan Africa by Negash, et al 2013, where the ratio of patient to HW was not directly proportional that ended up creating a lot of pressure and anxiety amongst HWs leading to errors.

**Lack of motivation of the HWs**
Though to a lesser extent, absence of motivation in form of salary increments, accommodation within the hospital premises, recognition for excellent performance and appraisals demoralizes health workers from performing their duties diligently. This is because the HWs feel they are not appreciated for their tireless efforts and good works. In such a working environment medication errors are inevitable as most HWs develop negative and I don’t care attitude towards work.

**Having a wide range of similar drugs on the market which creates confusion**
The ever increasing numbers of new medications on the market as a result of vigorous research and development by pharmaceutical companies has yielded many drugs of different brands, dosage forms and routes of administration on the market. It is not possible for the HWs to get acquainted with all the medications, some HWs especially the prescribers and pharmacy personnel are usually given incentives to prescribe such new medications without them getting to know very well all aspects related to the use of the medications. This has to some extent contributed to errors at the hospital and indeed corresponds to a study conducted by Tang, Sheu et al 2007 in Taiwan.
CHAPTER SIX: CONCLUSION, RECOMMENDATION AND LIMITATIONS

6.0 CONCLUSION

The findings of this study indicate that medication errors are still a big challenge to the health care system and more needs to be done so as prevent their occurrences inorder to improve the patient health and welfare.
Administration errors led to majority (57.25%) of the medication errors, followed by dispensing errors (53.1%) and lastly prescription errors (35.71%) as observed amongst patient files within the in- patient wards of ARRH.
Antibiotics were ranked number one with (80%) amongst drugs prone to medication errors followed by others with (15%) and finally analgesics with (5%).
Following medication error occurrence, gynecology ward was ranked number one with 53.42%, followed by the surgical ward (39.78%), then the medical ward (39.6%) and lastly the pediatric ward (19.24%).
Negligence amongst HWs was the most important individual factor responsible for the occurrence of medication errors while workload as a result of under staffing wasthe leading organizational factor responsible for errors.
Desire to avoid mistrust by patients (79.6%) and fear of being rated incompetent (75.9%) were the main hindrances to reporting of medication errors followed by fear for negative outcomes of errors and fear to be blamed which were reported by 72% of the HWs.
According to the study, there was no relationship between socio-demographics (age, religion, marital status) and occurrence of medication errors in ARRH.

6.1 Recommendations
The current study captured the occurrence of medication errors at the in-patient departments of ARRH. It is thus recommended that future research studies should consider both the in-patient and out-patient departments of ARRH to determine where the errors are most prominent and as well capture errors per prescription rather than per ward only.
The study on occurrence of medication errors needs to be carried out across the country so as to provide an overall prevalence of medication errors in the Ugandan health systems. There is need to follow-up and supervise health practitioners while at work. And also encourage peer supervision and monitoring while at work which helps to reinforce work ethics. The hospital administration should boost the relationship and strengthen communication amongst HWs by organizing activities such as get together sessions, retreats and end of year parties.

**Limitations**

We were unable to compile information regarding number of errors per prescription during our study due to the limited time we had.
REFERENCES


Maurer, M. J. (2010). "Nurses' perceptions of and experiences with medication errors."


APPENDICES

Appendix I: (a) Informed Consent Form for Health Care Workers.
A study to assess medication errors at the inpatient department of ARRH.

Investigators:

<table>
<thead>
<tr>
<th>NAME</th>
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<td>0783605645</td>
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<tr>
<td>BACIA LAURA</td>
<td>Makerere University, Kampala</td>
<td>0779816896</td>
</tr>
</tbody>
</table>

Study sponsor
A self-sponsored research study.

Background and rationale of the study
Medication errors are inevitable events that are currently posing a threat to the health care system worldwide with consequences such as therapeutic failure, antibiotic resistance, ADRs, mortality and loss of confidence in the health care system. The study is therefore focussed on establishing the prevalence of medication errors and the drivers to medication errors so as to devise means of minimizing such error occurrences.

Purpose
This study is aimed at assessing medication errors occurring during prescription, dispensing and administration of the different classes of drugs. This is will encounter commonly used medications at all levels of the healthcare systems. It also seeks to determine the hinderances to error reporting among health workers and establish the drivers of medication errors.
Study Procedure

You will be provided with semi-structured questionnaires and interview guides requiring you to provide honest responses. This process will take in-between 5 to 15 minutes.

Study participants

A total of up to 67 health workers including key informants such as the medical superintendent, heads of department, head of medicines and therapeutics committee and the hospital pharmacist plus other health workers such as the doctors, nurses, dispensers and intern practitioners shall be requested to get involved in the study.

Risks/discomforts

Minimum risks may be involved. The research may be inconveniencing as it may end up consuming some of your time.

Benefits of the study

The research participants won’t directly benefit from the study however, information obtained will be used to provide strategies of curbing errors so as to ensure patient safety and as well protect the rights of health care professionals.

Alternatives

The study participants are free to withdraw from the study at any point of their convenience.

Cost

All the necessary expenses during this study shall be met by the researchers themselves and not the participants.

Compensation for participants

No form of compensation shall be provided to the study participants.
Questions

In case of any questions related to the study, you can reach us through the contact documented below (MWAWULE.W.FREDRICK. 0783605645. mwawulefredrick@gmail.com).

Questions about participant’s rights

For any questions about your rights as a research participant, please contact Dr. KUTYABAMI PAUL (0772404970), the chairperson Institution Review Board, School of Health Sciences, Makerere University.

Feedback on study findings and progress of the study

The research findings will be availed to the hospital administration and the heads of the respective departments at the hospital.

Statement of voluntariness

Participation in the study is not compulsory and so participants are free to join and withdraw from the study at any time without a penalty.

Approval of the study

Approval to carry out this study will be obtained from the IRB /Research and Ethics committee of Makerere University, School of Health Sciences.

Confidentiality

The results of this study will be kept strictly confidential, and used only for research purposes. My identity will be concealed in as far as the law allows. My name will not appear anywhere on the coded forms with the information. Paper and computer records will be kept under lock and key and with password protection respectively. The interviewer has discussed this information with me and offered to answer my questions. For any further questions, I may contact the chairperson of the School of Health Sciences Research and Ethics Committee on (+256)772-404970/ (+256)0200903786/ or Uganda National Council of Sciences and Technology. Tel: (+256)-041-4705500.
Statement of consent

…………………………… has described to me what is going to be done, the risks, the
benefits involved and my rights regarding this study. I understand that my decision to participate
in this study will not alter my usual medical care. In the use of this information, my identity will
be concealed. I am aware that I may withdraw at any time. I understand that by signing this form,
I do not waive any of my legal rights but merely indicate that I have been informed about the
research study in which I am voluntarily agreeing to participate. A copy of this form will be
provided to me.

Name……………………….. Signature of the participant ………………… Age ........

Date ......................... (DD/MM/YY)

Name of interviewer ...................... Signature of interviewer ......................

Date ............................. (DD/MM/YY)
(b) Informed Consent Form for patients.

A study to assess medication errors at the inpatient department of ARRH.

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Purpose

This study is aimed at assessing medication errors occurring during prescription, dispensing and administration of the different classes of drugs. This will encompass commonly used medications at all levels of the healthcare system. It also seeks to determine the hindrances to error reporting among health workers and establish the drivers of medication errors.

Study Procedure

You will be requested to provide the researchers with your medical files bearing prescriptions and medication charts which will be used by the researchers to check out for errors regarding prescription, dispensing and administration. This process will take in-between 5 to 15 minutes.
Study participants

A total of up to 309 patients from the various wards shall be requested to participate in the study.

Risks/discomforts

Minimum risks may be involved. The research may be inconveniencing as it may end up consuming some of your time by keeping your medication files away from you for some time.

Benefits of the study

The research participants won’t directly benefit from the study however information obtained will be used to provide strategies of curbing errors so as to ensure patient safety.

Alternatives

The study participants are free to withdraw from the study at any point of their convenience.

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All the necessary expenses during this study shall be met by the researchers themselves and not the participants.

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Name………………………… Signature of the participant ……………….. Age ………

Date .............................. (DD/MM/YY)

Name of the witness.........................Signature/thumbprint..............................

Date............................. (DD/MM/YY)

Name of interviewer ......................... Signature of interviewer .........................

Date ............................. (DD/MM/YY)
RU KUSA ISUZU ‘BA AZORU VU I YI MA BUKU/KARATASI ‘BANI AROO SIZU
DRINIA RI AYUZU ONITA ‘DI MA ALEA (LUGBARA DIALECT)

ONITA EYO’ I BIPI EZATA AROO AYUZA BE ARUA AROJOA WODI NDUNDU MA
ALEA RI.

‘BA ONITA ‘DI MA DRI CE PIRI IKI.

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<tr>
<th>RU</th>
<th>SUKULU ENGAZURI</th>
<th>SIMU NAMBA</th>
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Eyo’ iti eceza were onita ‘di madria

Ezata ide pi dactari, naasi, kani ku ‘ba aroo awapi ‘di yi pie saawa yini aroo feria ‘ba azoru dri eri afazi ide pi drile onzi si ra nyaku ‘di ma dria nduluku. Drile onzi ‘di yi fe saawa azini si a roo nga azi ‘ba azoru ma rua ku, arooni ba fuzu fufu, azini eri fe ‘ba azoru ‘diyi ni apizu aroojo siku.

Asisile ama ni lezu eyo’ ‘di onizuri lezu nizu omgbo drile onzi ‘dini nizu, azini a’dini afa nde feni ama ni ani geriko ndazu eyo’ nde atrizu ‘beni.

Asisile onita ‘dini

Lezu nizu omgbo ezata drile onzini i bipi aroo ayuza be ‘ba azooru ma eselea wodi ndundu aroojo ‘di ma alea ria, azini adi’ ni i yi feni.

Geri ko onita ‘dini muzu i de zuri

Ama rukusa ai’ mivu ‘ba azoru/ ‘ba eri ma ageyi tepi ‘di vu ama azako zu buku/ karatasi ‘bani aroo sizu drini a midri ‘da fezu ama ni ezata ci drinia ‘da ndrezu, ama ani ecozu azakoma ecopi ra ri fezu emini beni.

‘Ba ecopi fipi onita ‘di ma alea rari

‘Ba ogogo kalafe turu na drini oromi (309) azoru engazu wodi ndundu ma alea aroojo ‘arua ni ma alea ‘diyi eco fizu onita ma alea ra.
Eyo’ onzi ecopi i bipi onita ‘di beri

Eyo’ azi onzi mini eco isu onita ‘dibe rani yo, kani raria ama nga mi saawa azi eza were amani mi buku/ karatasi aroo vile ri ayuria ndreza ru.

Orodri mini eco isule onita ‘di ma alea ri

Inga ni afa zi isu dria dria ru ama vuku. Kani ra ria,ezata drileonzi ni ama ni isule buku/ karatasi aroo ni madria ‘di ama nga ayu geriko ndazu ecozu ezata ‘dini le ‘di atrizu.

Aje onita ‘di ni

Aje onita ‘di niri ni nga ovu ofeza ru ‘ba onita ‘di ma dri ce ‘bari vusi. ‘ba nga ni sende ai mivu ku.

Ofeta ofeza ‘bani eco fe ‘ba fipi onita ‘di ma alea rini

Afa zi a mani eco ofe mini rani yo. Kani si mungu ma fe mini atita azini rua alaru, drileba ‘be indi eli ‘di ma alia.

Zita ziza onita ‘di ma dria

Mi zita azini ka adri ci onita ‘di ma dria, igba amani simu namba amani fele mini karatasi ‘di ma dria ri si.

Zita zizu driwala mini onita ‘di ma dria ri ni

Mi eco simu gba agupi rube dactari KUTYABAMI PAUL ru ‘di ni raa. (0772404970), ogua i onita ‘di ma drile ni Makerere yunivasitia ri.

Eyo’ isule onita ‘di ma alea ri ayuzu ngoni ru.

Eyo’ ci amani isule onita ‘di ma alea ri ni nga ovu feza ru drice za aroojo arua ni ri dri azi ngazu.

Mi ma asisile eceza fizu onita ‘di ma alea ri

Mi ma fita onita ‘di ma alea ri ovuni okposi ku. Le ma enga mi asia ka. Mi co fi azini fu onita ‘di ma alea ri si saawa ci mini egari si. ‘ba azi ngani mini panga fe ani ku.
Rukusa onita ‘dini

Ama isu rukusa onita ‘di edezu ri engazu amuti ru be IRB onita ‘di ma eyo’ ondrepi Makerere yunivasitia ri vu.

Geriko ecozu eyo’ isule mivule buku/ karatasi dria ‘di fu amve ereza ru ‘ba pi ma tia ku beni( eyo’ zizu)

Eyo’ ci ama ni isule mivu ri ni nga ovu zizaru. Anga ni miru ece kani ku eyo’ mi bukua/ karatasi aroo ni ‘di ece ba azi drik. Ani ori ma nde mi eyo’ azini si ku.

Ecezu kini ma ai fizu onita ‘di ma alea ra

………………………………………………….eyo’ dria i bipi onita ‘di beri ovu eceza ru ma dri ra azini fi ma dria kililiru. Ma ai eyo’ nde ri ra adisiku ni, onzi kani orodri onita nderi ni ovu eceza ru ma dri muke muke. ‘ba lu vini ma dri kini fita onita ‘di ma alea ri ni enga ma asia ovuni okposi ku. ‘ba fe vini ma dri karatasi ‘di ma azi ra.

Ru………………………….. Alama………………………….Mima Eli………………

Mba o’du(o’du/mba/eli)………………………………………………………….

‘Ba onita ‘di ma dri ce piri ma ru………………………. Alama……………………

Mba o’du(o’du/mba/eli)…………………………………………. 
PART 1: SOCIAL DEMOGRAPHIC INFORMATION OF HEALTH WORKERS

1. Age of the respondent in years………………………………..

2. Sex:      Male
             Female

3. Religion:   Christian
             Muslim
             Others (specify) ……………………………..

4. Marital status:  Single
             Married
             Others (specify) …………………….

5. Ward :        Medical/pediatric/gynecology/surgical

5. Qualification

Clinical officer  Physician  Pharmacist
Nurse            Pharmacy technician Others (specify) …………………….

3. Working experience in years …………………………………..
PART 2: Prevalence of the different types of medication errors at the in-patient wards of ARRH.

i) What do you think are the commonly occurring medication errors?

<table>
<thead>
<tr>
<th>Patient information</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Omission of admission date</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Omission of patient weight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Omission of patient age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Omission of patient name</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prescription errors</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct drug dose</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correct dose frequency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legible handwriting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abbreviated/full name of drugs/units of measure for the drugs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prescribed generic drugs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polypharmacy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others (specify)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Administration errors</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Incorrect drug administered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incorrect time of drug administration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incorrect route of drug administration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incorrect dose being administered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incorrect dosage form being administered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incorrect frequency of drug administration</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ii) What drugs are more prone to medication errors(tick more than one box where possible)?

<table>
<thead>
<tr>
<th>Drug Type</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antibiotics</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Analgesics</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Antihypertensives</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Antidiabetics</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Antiasthmatics</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Others (specify)</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

Dispensing errors

<table>
<thead>
<tr>
<th>Error Description</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cross-checked the prescription against medicines before dispensing</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Confirmed the allergy history of the patient in conjunction with prescribed drugs</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Dispensed out drugs to the wrong patient</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Omission of drugs</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Dispensed out excess drugs</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Dispensed out less drugs</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Made directions on the dispensing packs</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Gave out proper instructions for medication use</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
Appendix III: Interview guide to key informants

Drivers of medication errors

1) What individual factors contribute to medication errors? (Consider the following; negligence, working experience, health worker’s attitude and communication amongst health workers among others).

2) What institutional factors could predispose the hospital to medication error occurrences? (Bear in mind; lack of CPE trainings, workload, motivation, multiple medications on the market)

3) What do you think could be done to prevent occurrence of medication errors?
Appendix IV: Study questionnaire for health workers

Hindrances to medication error reporting at ARRH

i) What factors hinder reporting of medication errors (Rate the responses below from a range of 1 to 5)?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blaming of health practitioners by the top administration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fear for the negative outcomes of medication errors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desire to avoid mistrust by patients</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fear of being rated incompetent</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fear for reactions from the top hospital administration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fear of responses from fellow health workers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fear for losing a job</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of health practitioner’s protection against litigation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of a feedback report to the health workers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of an error reporting system</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure to know what to categorize as a medication error</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure to recognize that an error has occurred</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ii) What can be done to enhance medication error reporting?
## Appendix V: The Work Plan

<table>
<thead>
<tr>
<th>Activity</th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sept</td>
<td>Oct</td>
</tr>
<tr>
<td>Proposal development</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proposal presentation to the pharmacy department and submission to IRB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-testing tools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data collection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data entry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dissertation writing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presentation of a dissertation to the pharmacy department lecturers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Submission of a dissertation to the pharmacy department</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix VI: Budget estimate.

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Unit cost (UGX)</th>
<th>Cost (UGX)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pens</td>
<td>6</td>
<td>1000</td>
<td>6000</td>
</tr>
<tr>
<td>Paper work</td>
<td>4 reams of paper</td>
<td>7000</td>
<td>28000</td>
</tr>
<tr>
<td>Typing and photocopying</td>
<td>10 copies</td>
<td>15000</td>
<td>150000</td>
</tr>
<tr>
<td>Printing and binding</td>
<td>4 copies</td>
<td>5000</td>
<td>20000</td>
</tr>
<tr>
<td>Flash disk (30GB)</td>
<td>1</td>
<td>25000</td>
<td>25000</td>
</tr>
<tr>
<td>Tape recorder</td>
<td>1</td>
<td>30000</td>
<td>30000</td>
</tr>
<tr>
<td>Research assistants</td>
<td>2</td>
<td>100000</td>
<td>200000</td>
</tr>
<tr>
<td><strong>Sub-total</strong></td>
<td></td>
<td></td>
<td><strong>459000</strong></td>
</tr>
</tbody>
</table>

**Others**

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Unit cost (UGX)</th>
<th>Cost (UGX)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lunch and supper (x 4)</td>
<td>For 14 days</td>
<td>8000/day</td>
<td>448000</td>
</tr>
<tr>
<td>Airtime</td>
<td></td>
<td></td>
<td>20000</td>
</tr>
<tr>
<td>Transport x2 (To and Fro)</td>
<td></td>
<td>150000</td>
<td>300000</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td></td>
<td></td>
<td>300000</td>
</tr>
<tr>
<td><strong>Grand total</strong></td>
<td></td>
<td></td>
<td><strong>1527000</strong></td>
</tr>
</tbody>
</table>
March 25th, 2019

Mr. Fredrick Mwaule & Ms. Laura Bacia
Department of Pharmacy
School of Health Sciences
College of Health Sciences

Dear Mr. Mwaule & Ms. Bacia

Re: Approval of research protocol #SHSREC REF: 2018-075
"Assessment of Medication Errors in the In-Patient Wards of Arua Regional Referral Hospital, Arua District Uganda"

Thank you for submitting an application for ethical review of the above-referenced research protocol.
The committee reviewed it and granted approval for six (6) months, effective March 25th, 2019.
Approval is valid until October 25th 2019.

Continuing Review
In order to continue work on this study (including data analysis) beyond the expiration date, the School of Health Sciences Research and Ethics Committee must reapprove the protocol after conducting a substantive, meaningful, continuing review.
This means that you must submit a continuing report form as a request for continuing review. To best avoid a lapse, you should submit the request six (6) to eight (8) weeks before the lapse date. Please use the forms supplied by our office.

Amendments
During the approval period, if you propose any change to the protocol such as its funding source, recruiting materials, or consent documents, you must seek School of Health Sciences Research and Ethics Committee approval before implementing it.

Please summarize the proposed change and the rationale for it in a letter to the School of Health Sciences Research and Ethics Committee. In addition, submit two (2) copies of an updated version of your original protocol application— one showing all proposed changes in bold or ‘track changes,’ and the other without bold or track changes.

Reporting
You should report the progress of the study to SHSREC

Do not hesitate to contact us if you have any questions. Thank you for your cooperation and commitment to promote research in Uganda.

It is your responsibility to inform us in the event of early termination of the research project or if you fail to complete the research project.

Adverse events, including unanticipated or anticipated but severe physical harm to participants.

Monitoring
The Research and Ethics Committee has a duty to ensure that all research is conducted in accordance with the research governance code of practice. In order to ensure compliance, the School of Health Sciences Research and Ethics Committee undertakes random monitoring audits. If your research project is selected for monitoring audit, you will be given three (3) week’s notice to prepare all documentation for inspection.

Documents approved for use along with protocol include:
- Informed consent form for health care worker (English version)
- Informed consent form for patients (English version)
- Translated informed consent for patients (Lugbara version)
- Questionnaires (English version)
- Interview guide for key informants

Note: Only stamped informed consent forms, assent forms and data collection forms should be used for data collection. Any data collected using unstamped informed consent and data collection forms will be considered invalid.

Do not hesitate to contact us if you have any questions. Thank you for your cooperation and commitment to the protection of human subjects in research.

Final approval is to be granted by Makerere University for Science and Technology.

Yours sincerely,

Mr. Paul Kutyabami
Chairperson, School of Health Sciences Research and Ethics Committee
IN ANY CORRESPONDENCE ON THIS
SUBJECT PLEASE QUOTE:
Our ref: ARRH/164/2
Email: aruarefhosp@gmail.com

MINISTRY OF HEALTH
Arua Regional Referral Hospital
Office of the Hospital Director
P. O. Box 3,
ARUA, Uganda.

Date: 8/4/2019

BACIA LAURA
MWAWULE W. FREDRICK

PERMISSION TO COLLECT DATA

This serves to confirm that the above named students have been granted permission to collect
data for research at Arua Regional Referral Hospital.

Please note that this placement is subject to terms and conditions as established by the hospital
management board

We look forward to working with your student.

Thank you.

[Signature]
Dr. Aniku Gilbert

FOR: HOSPITAL DIRECTOR
ARUA REGIONAL REFERRAL HOSPITAL